2.2.2 Normal Test Source Voltage

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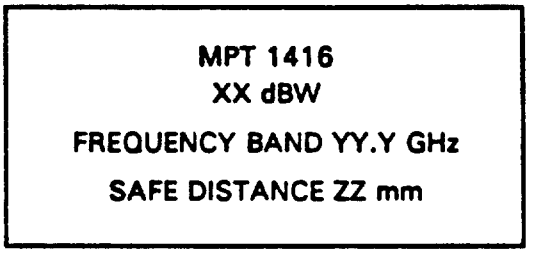
Part 1

1.5 Labelling

The equipment shall be provided with a clear indication of the type number and description under which it is submitted for type testing. Each number shall be unique and in the case where the testing authority finds two manufacturers have used a similar type number, one manufacturer shall be asked to change the type number.

Type approved equipment shall be permanently marked with an approved Inspection mark which shall be located on the outside of the equipment and be immediately visible. The minimum dimensions of the Inspection mark shall be 10 x 15 mm. The location of the Inspection mark shall be agreed between the manufacturer and the testing authority and shall be recorded in the test report.

The mark used to indicate compliance shall be as shown in Figure 1.1.



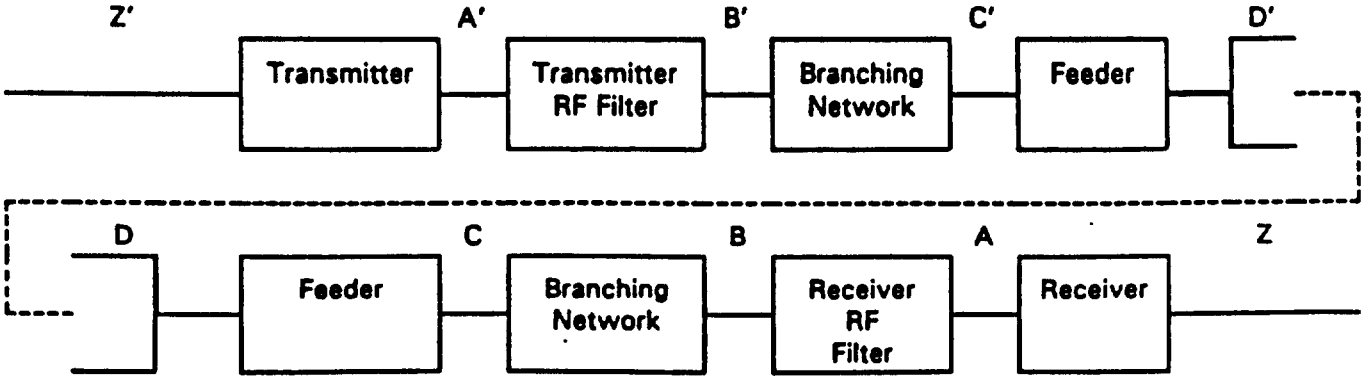
Letter & figure height shall be not less than 2 mm.

FIGURE 1.1

1.6 Input and Output Port - Definitions

1.6.1 For the purpose of the specification the terms "transmitter input port", "receiver input port", "transmitter output port" and "receiver output port" shall be taken to refer to those points corresponding respectively to the ports Z', C, C' and Z in Figure 1.2. Points Z' and Z are baseband input and output points respectively.

1.6.2 Accessibility for measuring R.F. power is referred to in Section 2.1.



Note: 1. For the purpose of defining the measurement points, the branching network does not include a

before making measurements, the equipment shall be placed in a temperature controlled chamber for a period of one hour or for such a period as may be judged necessary for thermal balance to be obtained. The equipment shall be switched off during the temperature stabilisation period. During these tests at extreme temperatures the humidity content in the test chamber shall be controlled so that it lies within the ranges given in clauses 2.4.1..(a).

2.5.2 Test Procedure

For tests at the upper temperature, after thermal balance has been attained (Clause 2.5.1), the equipment shall be switched on in the transmit condition for half an hour, after which the appropriate tests shall be carried out.

For tests at the lower temperatures, after thermal balance has been attained (Clause 2.5.1) the equipment shall be switched on in the receive or transmit condition for 30 minutes, after which the appropriate tests shall be carried out.

3 CABINET RADIATIONS

3.1 Definition

Cabinet radiations are emissions at any frequency, other than those of the carrier and associated sidebands, radiated from the cabinet structure of the equipment.

3.2 Specification Limits

Cabinet radiations shall be minimised in order to avoid interference to other radio installations. In the event of interference being traced to cabinet radiations the licensees will be required to provide interference suppression to a degree which shall be satisfactory to the Secretary of State.

4 INTERPRETATION OF THIS SPECIFICATION

In the event of doubt arising over the interpretation of this specification, or the method of conducting the tests, the decision of the Testing Authority shall be final.

5 Accuracy of Measurement

The tolerance for measurement of the quantities shown below will be as indicated.

5.1	DC Voltage	± 3%
5.2	AC Mains Voltage	± 3%
5.3	AC Mains Frequency	± 0.5%
5.4	Radio Frequency	± 100 kHz
5.5	Radio Frequency Power	± 1 dB
5.6	Return Loss	± 1 dB
5.7	Attenuation of Attenuators	± 1 dB
5.8	Temperature	± 1°C
5.9	Humidity	± 5%
5.10	BER	20% Accuracy 95% Confidence level

MPT 1416

PART 2

PERFORMANCE SPECIFICATION

Private Fixed Link Radio Equipment with Digital Modulation

up to 155 Mbit/s for use in the Frequency Band

54.25 GHz to 57.2 GHz

CONTENTS

1 General Conditions

1.1 Arrangements for Test Signals Applied to the Receiver Input

Sources of test signals for application to the receiver input shall be connected in such a way that the return loss presented to the receiver input is not less than 23 dB.

This requirement shall be met irrespective of whether one or more signals are applied to the receiver simultaneously.

The levels of the test signals shall be expressed in terms of the power in dBW incident at the receiver input port.

The effect of any intermodulation products of noise produced in the test equipment shall have a negligible effect.

1.2 Standard Test Signal

(a) The standard test signal shall be a modulated radio frequency carrier having the same phase and amplitude transition shapes as the associated transmitter. The modulating data stream shall be encoded and/or scrambled to suit the receiver's processing. The modulating data stream shall be a pseudo random bit stream of repetition length and generator polynomial as shown in Table 2.1.

Table 2.1

Bit Rate	Repetition Length	Polynomial
2 Mbit/s	$2^{15} - 1$ Bits	$D^{15} + D^{14} + 1 = 0$
2 x 2 Mbit/s	$2^{15} - 1$ Bits	$D^{15} + D^{14} + 1 = 0$
8 Mbit/s	$2^{15} - 1$ Bits	$D^{15} + D^{14} + 1 = 0$
34 Mbit/s	$2^{23} - 1$ Bits	$D^{23} + D^{18} + 1 = 0$
140/155 Mbit/s	$2^{23} - 1$ Bits	$D^{23} + D^{18} + 1 = 0$

(b) If the transmitter and receiver in the equipment under test operate on the same radio frequency, the transmitter modulated in accordance with Clause 1.2(a) and with its output suitably attenuated, may be used to constitute the 'wanted' signal for the purpose of receiver selectivity measurement (Section 3.3).

1.3 Receiver Mute or Squelch Facility

If the receiver is equipped with a mute or squelch circuit, this shall be made inoperative for the duration of the type approval test.

1.4 Transmitter Artificial Load

Tests on the transmitter shall be carried out using a non-reactive non-radiating load connected to the transmitter radio frequency output port. The load shall have a return loss of not less than 23 dB.

2 TRANSMITTER

2.1 Frequency Error

2.1.1 Definition

The frequency error of the transmitter is the difference between the measured carrier frequency and its nominal value.

2.1.2 Method of Measurement

(a) The transmitter shall be operated in accordance with the manufacturer's instructions and its output shall be connected to an artificial load (Section 1.4).

(b) The emission shall be monitored by a frequency counter and the carrier frequency shall be measured in the absence of modulation.

(c) The measurement shall be made under normal test conditions (Part 1 Section 2.3) and repeated under extreme conditions (Part 1 Clauses 2.4.1 and 2.4.2 applied simultaneously).

2.1.3 Limits

The frequency error, under both normal and extreme test conditions shall not exceed ± 50 ppm.

2.2 Carrier Power

The maximum value of the effective radiated power of the carrier in an operating system will be a condition of the licence. Compliance with this requirement shall be achieved by a combination of the power range of the equipment and the antenna used.

2.2.1 Definition

The carrier power of a transmitter is the average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle taken under conditions of no modulation. (CW conditions).

2.2.2 Method of Measurement

(a) The transmitter output port shall be connected to an artificial load (Section 1.4) with means of measuring the power delivered to this load.

(b) In absence of modulation (ie CW conditions), the transmitter shall be operated in accordance with the manufacturer's instructions.

(c) The measurement shall be made under normal test conditions (Part 1 Section 2.3) and repeated under extreme test conditions (Part 1 Clauses 2.4.1 and 2.4.2 applied simultaneously).

2.2.3 Limits

The carrier output power under all test conditions shall be within ± 4 dB (for Outdoor Equipment) or ± 3 dB (for Indoor Equipment) of the rated output power declared in Part 1 Sub-Clause 1.4(c). The maximum output power shall not exceed 0 dBW under any conditions.

2.3 Spurious Emissions

2.3.1 Definition

Spurious emissions are emissions at frequencies which are outside the Necessary Bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude emissions on frequencies immediately outside the Necessary Bandwidth which result from the modulation process. The Necessary Bandwidth is defined as twice the transmitted symbol rate.

2.3.2 Method of Measurement

(a) The transmitter output port shall be connected to either a spectrum analyzer via an attenuator, or an artificial load with some means of monitoring the emission with a spectrum analyzer or selective voltmeter.

(b) The transmitter shall be unmodulated, (ie CW conditions). At each spurious emission from 1 GHz to 130 GHz, excluding frequencies within the Necessary Bandwidth about the carrier frequency, the level of the emission shall be measured relative to the level of the carrier emission. All levels should be measured at point C'.

(c) The power level of each emission shall be calculated by applying the ratio measured in Clause 2.3.2(b) to the carrier power determined in Section 2.2 under normal test conditions.

2.3.3 Limits

The power of any spurious emission measured in Clauses 2.3.2(b) & (c) shall not exceed:

1 GHz to 21.2 GHz	:	-90 dBW
21.2 GHz to 80 GHz	:	-60 dBW
80 GHz to 130 GHz	:	-50 dBW

Note:

(a) Methods of measurement for the frequency range 80 GHz to 130 GHz are yet to be agreed between European Administrations and the IEC.

(b) Definitions and methods of measurement of integrated equipment are UNDER STUDY.

2.4 Radiated Spectrum

2.4.1 Method of Measurement

(a) The transmitter output port shall be connected to either a spectrum analyzer via an attenuator, or an artificial load with some means of monitoring the emissions with a spectrum analyzer. The spectrum analyzer shall have a variable persistence display or digital storage display and its controls shall be adjusted as follows:-

Bit Rate (Mbit/s)	2	8	34	140
Channel Spacing (MHz)	14	28	56	140
IF Bandwidth (kHz)	30	100	100	300
Total Sweep Width (MHz)	As Appropriate			
Video Bandwidth (kHz)	0.1	0.1	1	1
Recommended Scan Time (s)	20	25	2	5

(b) The transmitter line input shall be modulated by a digital signal having the appropriate characteristics given in Table 2.1. The display shall be recorded, relative to the level of the unmodulated carrier as measured in clause 2.2.

(c) The measurement shall be made under normal test conditions (Part 1 Section 2.3) and repeated under extreme test conditions (Part 1 Clauses 2.4.1 and 2.4.2 applied simultaneously).

Note: Since the spectrum masks of Figure 2.3 incorporate an allowance for frequency stability, any deviation (measured in 2.1) from the nominal centre frequency (declared in Part 1, clause 1.4(a)(i)) must be taken into account when comparing the radiated spectrum with the limits of Figure 2.3.

(d) The transmitter line input shall be modulated by a digital signal having the characteristics indicated in Clause 1.2. The level of any residual carrier, shall be recorded, relative to the level of the unmodulated carrier as measured in clause 2.2.

2.4.2 Limits

(a) The 0 dB spectrum reference level (SRL) shown in the spectrum masks given in Figs 2.3A to 2.3D shall be set to the level calculated by the formula in sub-clause 2.4.2(c).

(b) The recorded spectra of 2.4.1(b) shall be compared with the appropriate figure in Figure 2.3. Spectrum peaks due to the modulation process shall not exceed +3 dB relative to the SRL, between 0 MHz and the first break-point of the mask (shown as a dotted line).

(c) The SRL shall be calculated using the following formula:

$$0dB\,SRL = Carrier\,Power - 10\log_{10}\left(\frac{Symbol\,Rate\,(Bauds)}{Analyser\,IF\,Bandwidth\,(Hz)}\right)$$

(d) The residual carrier level (2.4.1(d)) shall not exceed -10 dB relative to the value of the unmodulated carrier.

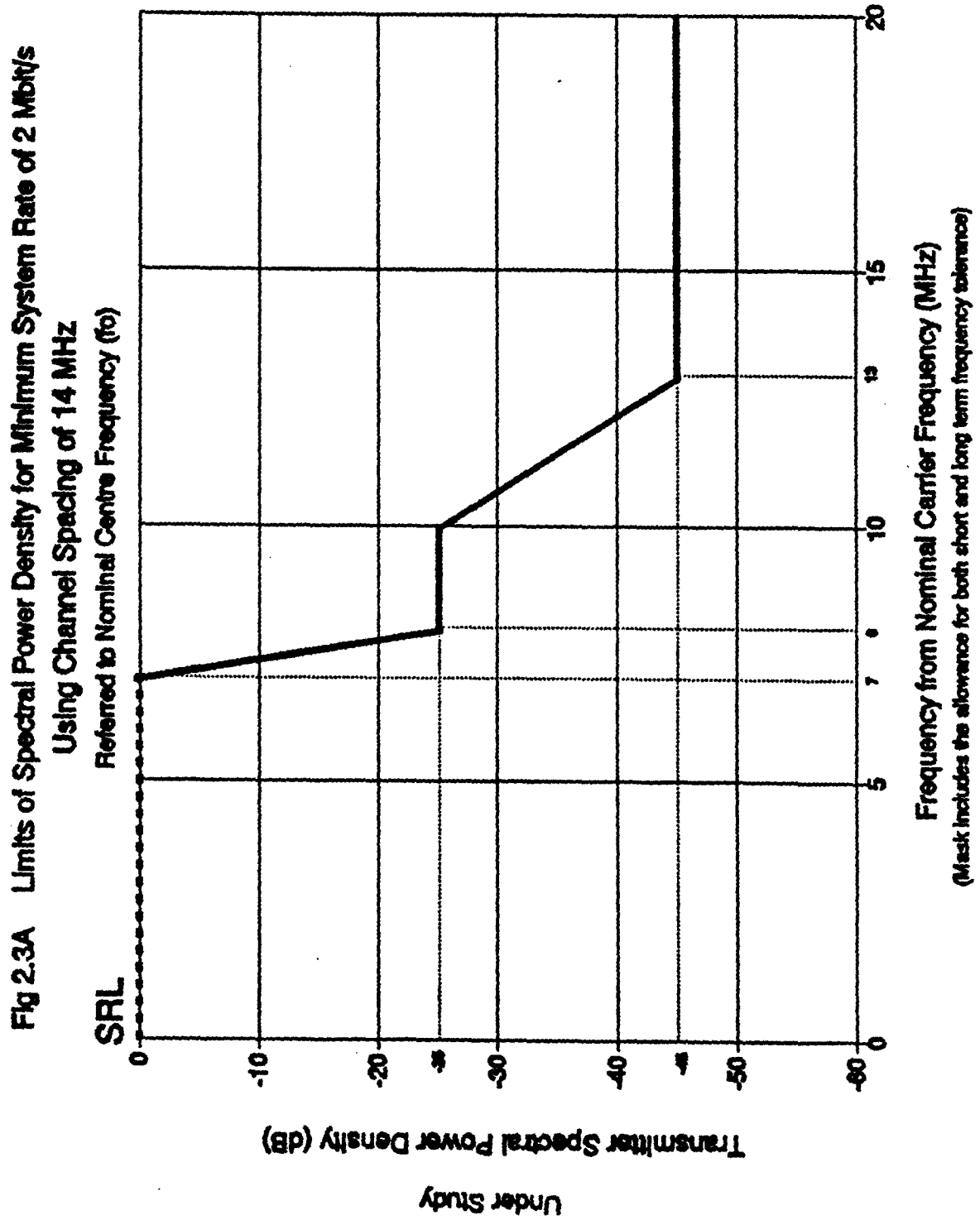


Fig 2.3A Limits of Spectral Power Density for Minimum System Rate of 2 Mbit/s
Using Channel Spacing of 14 MHz
Referred to Nominal Centre Frequency (fo)

Fig 2.3A Limits of Spectral Power Density for Minimum Bit Rate of 2 Mbit/s

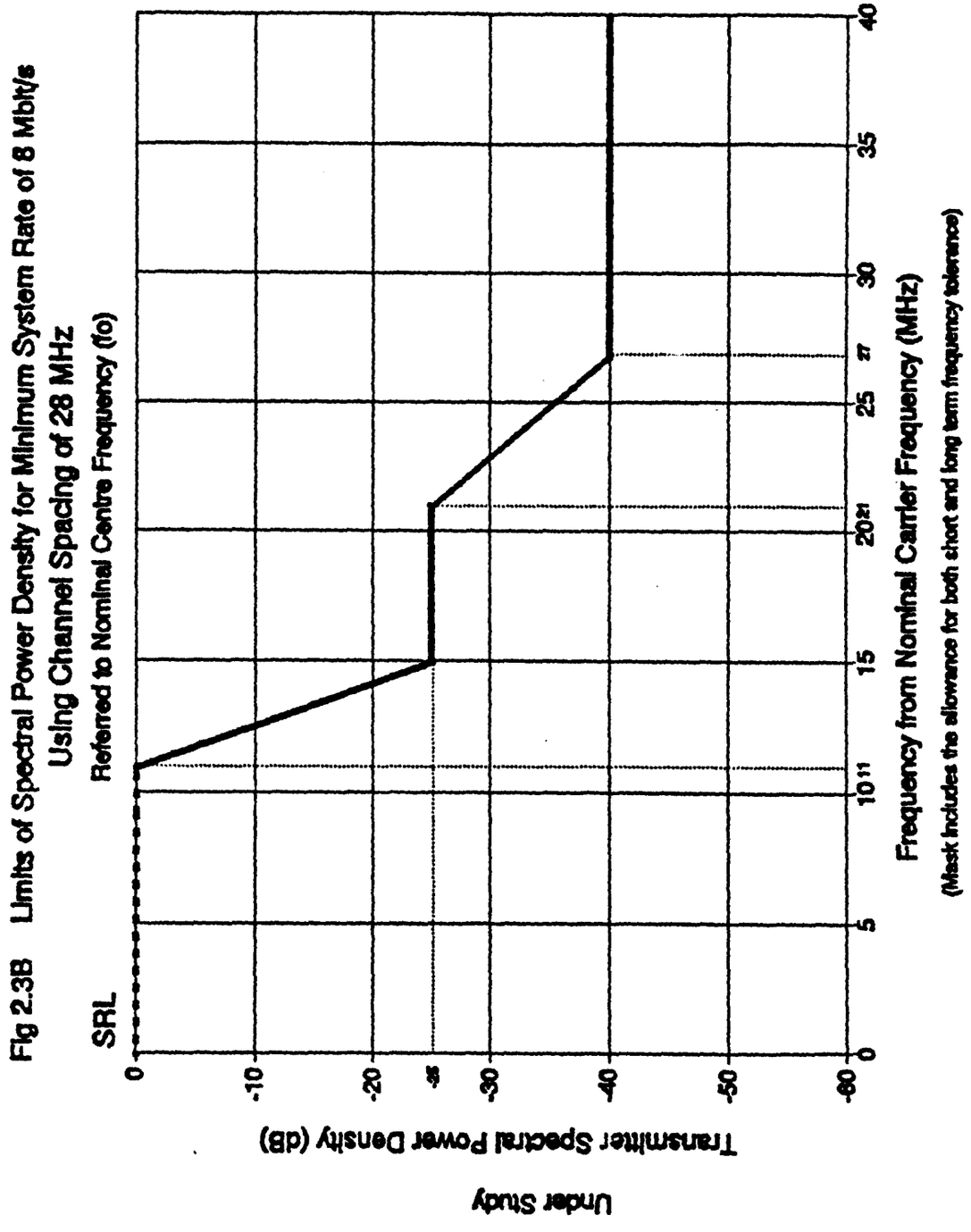


Fig 2.3B Limits of Spectral Power Density for Minimum Bit Rate of 2 x 2 Mbit/s

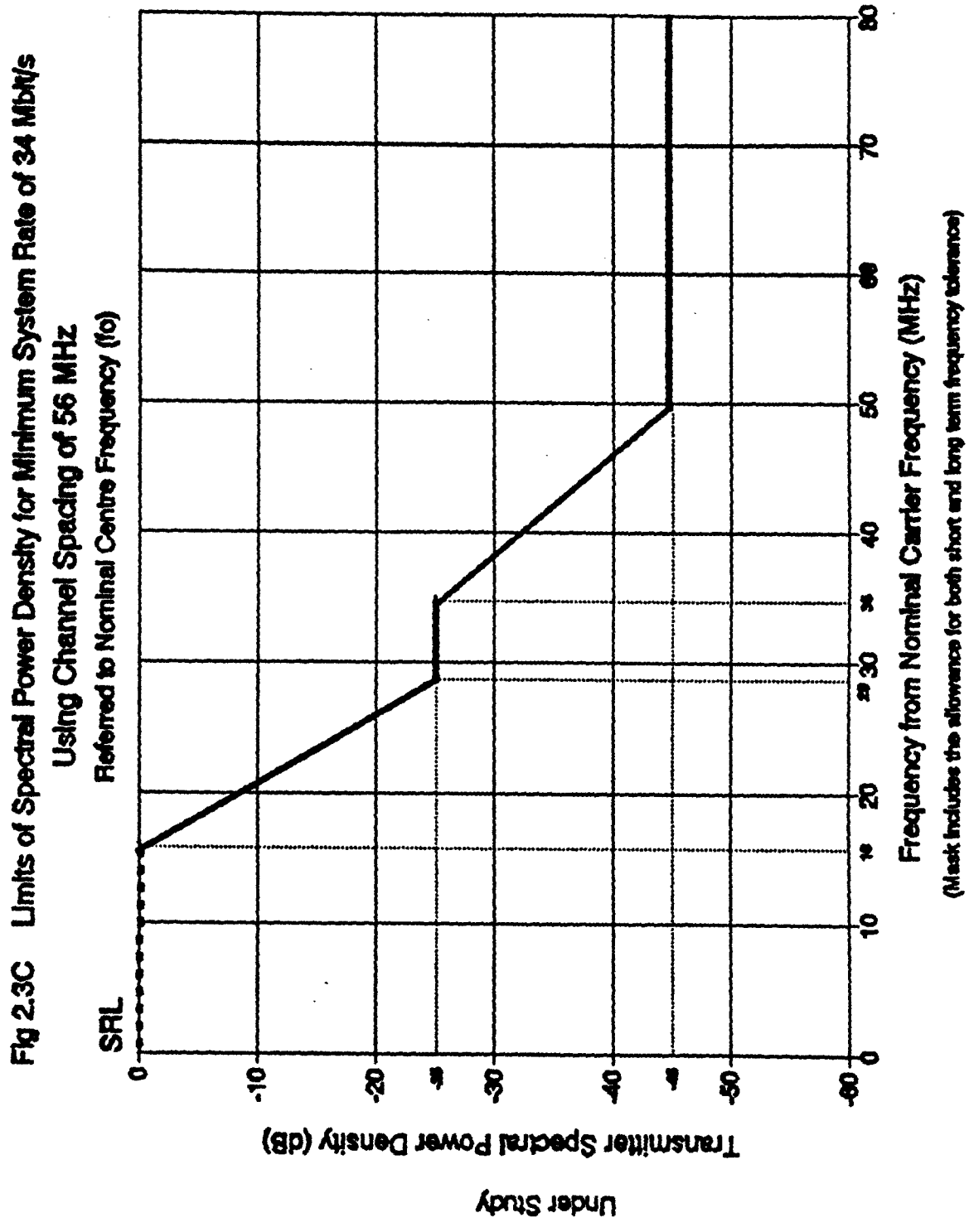


Fig 2.3C Limits of Spectral Power Density for Minimum Bit Rate of 8 Mbit/s

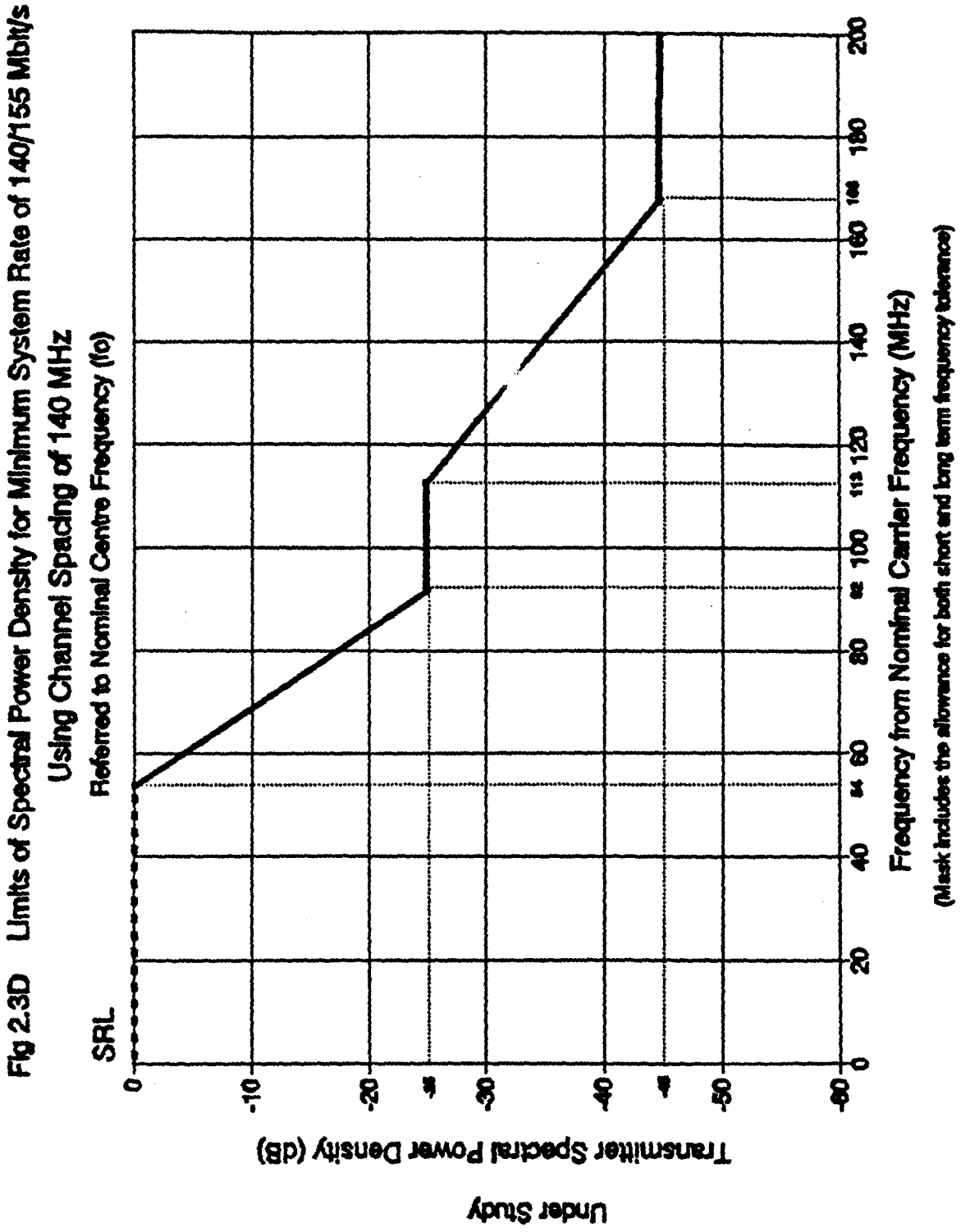


Fig 2.3D Limits of Spectral Power Density for Minimum System Rate of 140/155 Mbit/s Using Channel Spacing of 140 MHz Referred to Nominal Centre Frequency (fo)

Fig 2.3D Limits of Spectral Power Density for Minimum Bit Rate of 34 Mbit/s

3 RECEIVER

3.1 Input level range

The input level range for a BER $<10^{-6}$ shall extend from the upper limit of -50 dBW to the lower threshold for BER = 10^{-6}, measured at point C.

3.2 BER performance

The reference sensitivity of the receiver, for a BER of 10^{-6} is given in Table 2.2.

3.3 Selectivity

3.3.1 Definition

In the context of this specification the selectivity of the receiver is an indication of its ability to receive (with a given minimum quality) a wanted modulated signal at the normal received level (Median level) in the presence of an unwanted modulated signal of a given level, differing in frequency from the wanted signal by a specified amount.

3.3.2 Method of Measurement

3.3.2.1

(a) A bit error monitor capable of detecting errors in the sequence described in 1.2 at the bit rates of Table 2.2 shall be connected to the receiver output.

(b) A standard test signal (Section 1.2) shall be applied to the input port of the receiver via one path of a combining unit. The level of the signal at the receiver input port shall be the median signal level given in Table 2.2. The frequency of the standard test signal shall be that of the wanted receive frequency.

(c) An interfering test signal having the same characteristics as described in Section 1.2 shall be applied via the second path of the combining unit. The level and frequency separation of the interfering signal shall be as described in Table 2.2. Frequency separations specified in Table 2.2 are the receiver co-polar channel spacings.

Table 2.2

Bit Rate (Mbit/s)	Separation of wanted & interfering signals (MHz)	Level Interfering Signal (-dBW)	Median Signal Level (-dBW)
2	± 14	79	79
2x2	± 14	76	76
8	± 28	73	73
34	± 56	70	70
140/155	± 140	65	65

d) The BER of the wanted signal shall be measured.

...sponse Rejection

3.4.1 Definition

The spurious response rejection ratio of the receiver is a measure of its ability to discriminate between the wanted signal at the nominal frequency of the receiver and an unwanted signal at any other frequency at which a response is obtained.

3.4.2 Method of Measurement

(a) Referring to the test arrangement in Section 3.3 for measurement of the receiver co-channel interference sensitivity, the interfering signal source shall be replaced with an unmodulated source or sources capable of continuously tuning from 1 GHz to 130 GHz.

(b) The level of the unmodulated source shall be set to zero and the wanted signal varied in level until the BER is 10^{-3}.

(c) The level of the unmodulated source measured at the receiver input shall be 35 dB greater than that of the wanted signal.

(d) The frequency of the unmodulated interfering signal shall be varied over the range 1 GHz to 130 GHz, excluding frequencies either side of the wanted frequency by twice the relevant co-polar receiver channel spacing given in Table 2.2.

3.4.3 Limits

The BER shall not be worse than 10^{-3} at any point during the test.

3.5 Receiver Spurious Emissions

3.5.1 Definition

Spurious emissions from the receiver are any individual emissions present at its input port which is considered to be at the input of the receiver or diplexer if fitted.

3.5.2 Method of Measurement

(a) The transmitter output port shall be connected to either a spectrum analyzer via an attenuator, or an artificial load with some means of monitoring the emission with a spectrum analyzer or selective voltmeter.

(b) The power level of each emission in the frequency range 1 GHz to 130 GHz, excluding frequencies within the Necessary Bandwidth about the carrier frequency, shall be measured. All levels should be measured at point C'.

3.5.3 Limits

The power of any spurious emission from the receiver measured in Clause 3.5.2(b) including the local oscillator frequency generated by the receiver shall not exceed:

1 GHz to 21.2 GHz	:	-90 dBW
21.2 GHz to 80 GHz	:	-60 dBW
80 GHz to 130 GHz	:	-50 dBW

Note:

(a) Methods of measurement for the frequency range 80 GHz to 130 GHz are yet to be agreed between European Administrations and the IEC.

(b) Definitions and methods of measurement of integrated equipment are UNDER STUDY.

MPT 1416

PART 3

Antennas for Private Fixed Radio Services Operating in the Frequency Band 54.25 GHz to 57.2 GHz.

CONTENTS

1 GENERAL

1.1 Scope of Specification

This specification covers the minimum performance requirements for vertically polarised antennas to be used in the band 54.25 GHz to 57.2 GHz allocated to Public Telecommunications Operators and private fixed radio services. Two types of antennas are included, a directional and an omnidirectional type. The directional antennas are further classified into standard and high-performance versions. High performance antennas may be specified by the license applicant, in preference to Standard antennas, but may also be required by the Licensing Authority in cases which require improved spectrum efficiency.

1.2 Licensee's Responsibility

The installation of equipment, either fixed or mobile, is subject to the issue of a licence by the Secretary of State. Under the conditions of the licence it will be the responsibility of the licensee to ensure that the equipment provided conforms with and is maintained to the requirements of this specification. The requirement in this case is that the antenna shall be type-approved.

1.3 Labelling

Complete antenna assemblies shall be clearly identified with a weatherproof and permanent mark (or marks) showing the manufacturer's name and type number. Additionally the antenna shall display a mark indicating the orientation required to achieve vertical polarisation. Each antenna shall have a permanent label giving the value of the gain and the antenna type declared in 1.4.

1.4 Declarations

When submitting an antenna for type approval the manufacturer shall supply the following:-

(a) the nominal gain of the antenna, (note the value is the gain of the antenna type and not the gain of the particular sample).

(b) whether a Radome or Feed-Shroud is fitted to the antenna.

(c) whether it is directional or omnidirectional antenna.

(d) the working frequency of the antenna.

1.5 Test Arrangements

All performance testing of antennas will be carried out at a test site specified by the testing authority. Testing shall be carried out on dry antennas.

NOTE: Radomes shall be fabricated from hydrophobic materials to minimise the effect of water droplets on the radiation pattern. Testing of wet antennas is under consideration.Arrangements will be made for the applicant to deliver his antenna to the test site at least two weeks before testing is scheduled to begin.

Manufacturers may be required to participate in the mounting and dismantling of the antenna. Applicants will normally be expected to make arrangements to remove their

antennas from the test site within 14 days of receiving notification from the testing authority that tests have been completed.

NOTE: Tests may from time to time be cancelled or postponed at short notice due to unsuitable weather conditions.

1.6 Polarisation

The polarisation of radiation shall be within 5 degrees of Vertical.

1.7 Offshore Environment

Antennas to be used offshore shall additionally meet the environmental requirements of Chapter 2 of Radiocommunications Agency specification MPT 1405..

1.8 Interpretation of this Specification

In case of doubt about the interpretation of this specification the decision of the testing authority shall be final.

1.9 Testing Authority

The testing authority shall be Radiocommunications Agency or one approved by the Agency.

2 Technical Requirements

2.1 Definitions

Radiation pattern	A diagram relating power flux density or field strength at a constant distance from an antenna to the direction relative to the antenna main beam. The distance is required to be greater than the minimum far-field distance of the larger of the antenna under test or the reference antenna used for the radiation pattern measurement. The minimum far-field distance is given by the following formula: $$Minimum far\text{-}field distance = 6.7D^2F \text{ metres}$$ where: D is the aperture diameter of the larger of the antenna under test or the reference antenna, expressed in metres. F is the frequency in GHz.
Radome	A cover for an antenna system which is weatherproof and intended to be transparent to radio frequency energy.
Co-polar pattern	A diagram representing the radiation pattern of a test antenna when the reference antenna is similarly polarised, scaled in dBi or dB relative to the measured antenna gain.
Beam axis	The direction, within the major (main) lobe of a narrow beam antenna, for which the radiation intensity is a maximum.
Major/Main lobe	The radiation lobe containing the direction of maximum radiation.
Beam of an antenna	The major (main) lobe of the radiation pattern of an antenna.

Antenna gain — The ratio of power measured in the boresight direction to the level that would exist if the radiated energy (if the test antenna was considered to be in transmit mode) was uniformly distributed over a sphere centred on the test antenna, ie., an isotropic radiator radiating the same power as the test antenna. The antenna gain is expressed in dB above isotropic level and is denoted by dBi.

2.2 Directional Antenna

This section describes the approval test requirements, method of measurement and specification limits for the directional standard and high-performance antennas.

2.2.1 Approval Test Requirements

Approval tests will be conducted on the following antenna performance parameters:

(a) Gain

(b) Radiation Pattern

The values measured during the approval tests shall meet the limits outlined in Section 2.2.3, below.

2.2.2 Method of Measurement

Measurements shall be made at the test frequencies 54.25 GHz, 55.5 GHz and 57.2 GHz. The testing authority reserves the right to test at additional frequencies within the frequency range 54.25 GHz to 57.2 GHz should it be deemed necessary. If the antenna is designed for use with a radome or feed shroud, then measurements shall be made with this in place.

(a) Gain

The antenna gain will be measured using the gain by comparison technique in which the gain of the antenna under test is compared with that of a calibrated gain antenna typically a standard gain horn. In practice this will involve comparing the peak received power level of the omnidirectional antenna with the peak (boresight) level received from the standard gain horn. The gain of the antenna under test is the sum of the gain of the standard gain horn and the difference in observed peak power levels and is expressed in dBi.

Alternative methods can be proposed, providing the testing authority is satisfied that sufficient supportive evidence as to the suitability of the method of gain measurement has been providedc and agreed with the testing authority at least four weeks prior to the approval test.

(b) Radiation Pattern

The co-polar pattern shall be measured and plotted at each test frequency with the antenna polarised in the vertical plane.

2.2.3 Specification Limits

(a) Gain

The measured antenna gain shall meet the minimum requirements specified in Table 3.1 and be within ±2 dB of the value declared in 1.4.

TABLE 3.1 ANTENNA GAIN

Antenna Type	Minimum Gain (dBi)
Standard	32
High Performance	32

(b) Radiation Pattern

The values of the gain of the measured co-polar pattern of the antenna shall be equal to or less than the values given in Figures 3.1 and 3.2.

2.3 Omnidirectional Antenna

This section describes the approval test requirements, method of measurement and specification limits for the omnidirectional antenna.

2.3.1 Approval Test Requirements

Approval tests will be conducted on the following antenna performance parameters:

(a) Gain

(b) Radiation Pattern

The values measured during the approval tests will meet the limits outlined in Clause 2.3.3 below.

2.3.2 Method of Measurement

Measurements shall be made at the test frequencies 54.25 GHz, 55.5 GHz and 57.2 GHz. The testing authority reserves the right to test at additional frequencies within the frequency range 54.25 GHz to 57.2 GHz should it be deemed necessary. If the antenna is designed for use with a radome or feed shroud, then measurements shall be made with this in place.

(a) Gain

The antenna gain will be measured using the gain by comparison technique in which the gain of the antenna under test is compared with that of a calibrated gain antenna typically a standard gain horn. In practice this will involve comparing the peak received power level of the omnidirectional antenna with the peak (boresight) level received from the standard gain horn. The gain of the antenna under test is the sum

of the gain of the standard gain horn and the difference in observed peak power levels (taking into account the sign of the difference) and is expressed in dBi. The particular azimuthal pointing angle of the omnidirectional antenna shall be noted. The antenna is mounted at 0° elevation. The comparison shall also be made at three other positions separated from the noted azimuth position by 90, 180 and 270 degrees. The gain is the average value of the four measurements at each frequency.

Alternative methods can be proposed, providing the testing authority is satisfied that sufficient supportive evidence as to the suitability of the method of gain measurement has been provided and agreed with the testing authority at least four weeks prior to the approval test.

(b) Radiation Pattern

The radiation pattern response shall be demonstrated on a far field test range, in the azimuth and elevation planes. The co-polar patterns are measured at the test frequencies referred to above. Azimuth patterns will be recorded by mounting the antenna in its normal orientation (0° elevation) onto a single axis positioner.

The antenna shall be rotated about the positioner local vertical axis between -180 and +180 degrees; the signal level received from a fixed power output source shall be recorded as a function of angle.

Elevation patterns are measured by mounting the antenna at 90 degrees to its normal attitude and rotating about the positioner local vertical axis between -90 and +90 degrees. The received signal level shall be then recorded as a function of angle. The elevation patterns shall be measured at four different antenna azimuthal angle settings, typically spaced by 90 degrees.

2.3.3 Specification Limits

(a) Gain

The measured gain of the antenna shall be within ±2 dB of the value declared in Section 1.4.

(b) Radiation Pattern

The measured azimuth co-polar pattern of the antenna shall be within ±3 dB of the gain measured in 2.3.2(a).

The values of the gain of the measured elevation co-polar patterns of the antenna shall be equal to or less than the values given in Figure 3.3.